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CROP PESTS AND DISEASES I.*

Natural Limiting Factors.

No one concerned with agriculture will deny that pests and diseases are important factors affecting crop production. We have, on the other hand, grown so accustomed to seasonal infestations of greater or less extent that we sometimes fail to recognise how great is their effect upon yields and quality. Suffice it to say that, however conservatively estimated, figures of losses due to insect pests and diseases run to many millions of pounds every year in the tropics, and though it may be argued that moderate attacks are only of slight importance to the individual grower, none can afford to ignore the risk of serious loss and must needs adopt protective or remedial measures which, in themselves, represent a dead loss. Although it has a very important bearing on the choice of suitable control measures it is surprising to find that the problem of assessing the actual damage due to the depredations of insects and diseases has hitherto been somewhat neglected. More work is unquestionably needed on methods for obtaining a much closer estimate of such damage so as to decide whether measures of prevention or control will be economically justified. The application of the simplest of these measures is bound to cost something and it is probable that where losses are likely to be below a certain percentage, the best advice may be that it is not worth while to do anything. But, before advice of this kind can be given, much more accurate data as to losses actually incurred from attacks of pests and diseases are needed, and this lack of information obviously suggests a line of research work that might profitably be taken up.

We may at this stage usefully indicate some of the general principles underlying the working out of control measures. To do this we must first consider the chief factors affecting the *natural limitations* of the organisms concerned since our aim should be to supplement rather than replace such factors. In the first place it will be evident that *climate and weather* markedly influence the abundance of insects and fungi. Some pests, for example, that cause much loss in certain countries fail to establish themselves in others although their food plants are grown in quantity. Studies of the precise relationships between meteorological

* Adapted from an article by C. T. Gimingham, O.B.E., B.SC., F.I.C., in *Science Progress*, Vol. XXXIII, No. 132, 1939.

conditions and particular pests or diseases are also leading to the accumulation of information which is helpful in attempting to define their possible geographical range, and in some instances, notably in America, this has been done with considerable accuracy. The subject is of much practical importance in connection with measures that may be taken to try to prevent the introduction of new pests into a country, for it is useless to enact legislation to keep out pests which could not establish themselves if introduced.

In other directions, too, the study of weather in relation to the movement and abundance of insects has given results of much practical value and an interesting example concerns the possibility of growing stocks of seed potatoes relatively free from virus diseases. The investigations of Maldwyn Davies have shown that the meteorological conditions in certain areas are such that the population of aphides (green fly) which are carriers of virus diseases is at a minimum, and in such districts virus-free stocks can successfully be raised.

Another important factor is the *resistance to attack* shown by the plants themselves. As is well known, different varieties and strains of both wild and cultivated plants exhibit wide differences in the extent to which they are subject to infestation by pests and diseases, some being highly susceptible, others highly resistant or even completely immune. Plant breeders can take advantage of such variability by attempting to raise new varieties incorporating high resistance or immunity with other desirable qualities, and it will be realised that where this can be successfully done we have the most fundamental and satisfactory means of dealing with the problem, for artificial control measures then become no longer necessary. Considerable success has, in fact, already been obtained in some instances, particularly in regard to resistance to fungus diseases. For example, the College investigations into the genetics and breeding behaviour of bananas have resulted in the production of the seedling banana I.C.2 which is not only highly resistant to Panama Disease but also to Banana Leaf Spot disease. More recently a search in South America for varieties of cacao which it is hoped will prove highly resistant, if not immune, to witchbroom disease, has produced some promising material. Instances of the production of new varieties of plants highly resistant to insect pests are less numerous but it may be mentioned in passing that attempts are now being made to breed sugar canes resistant to froghopper blight.

Lastly, a factor of no less importance, affecting the natural limitation of insects and fungi, is the effect of *natural enemies* of the pests or disease-producing organisms. Parasites and predatory insects, birds, and certain mammals, fungous and bacterial diseases all take their toll of insect pests; and fungi are also subject to attack by certain insects and by other fungi. Of these natural enemies, insect predators and parasites are the most important. They may be entirely responsible in certain instances for preventing the numbers of a potential pest from reaching the level at which it becomes harmful; a balance normally ensues, determined, in the case of parasites, mainly by the relative rates of reproduction of the parasite and its host under the prevailing conditions. In special circumstances the introduction of natural enemies of particular insects has led to strikingly successful practical results and further work is likely to extend the usefulness of such biological control methods.

It must not be thought that the various factors mentioned act in isolation. The relative abundance under natural conditions of a pest or disease is the resultant of the interaction of any or all of them: climatic conditions, host plant resistance, natural enemies, available food supply. As Dr. W. R. Thompson has put it: "Outbreaks of species are simply due to the fact that conditions momentarily correspond or approximate to the ecological optimum; control means simply a departure in one or many directions from optimum conditions to the point where the species is just able to maintain itself."

The ultimate practical aim of the study of the various natural agencies acting upon pests and diseases is to place us in possession of accurate data on which to base methods for altering the conditions in favour of the crop, that is, *methods of control*. We propose in another article to discuss some of these methods.

BLUE MOUNTAIN COFFEE.

In an article by S. M. Gilbert which appeared in *Tropical Agriculture*, Vol. XV, No. 3 under the title "Plot Size in Field Experiments with *Coffea arabica*", the coffee studied was described as being of the 'Blue Mountain variety'. According to A. C. Barnes, lately Director of Agriculture in Jamaica, Blue Mountain Coffee is not considered in Jamaica, to be a special variety. It is there regarded as 'ordinary' *Coffea arabica*; and the flavour for which it is so famous is believed to be due only to the conditions under which it is grown. In East Africa, however, the term is habitually used for a type of coffee derived from seed originally imported from Jamaica, which is considered by some authorities to constitute a variety, distinguishable in the field from other types of *Coffea arabica* growing in East Africa. The Director of Agriculture, Jamaica, has suggested that the correct designation of the coffee in question would be "East African Blue Mountain Coffee".—*Editor.*

The Editor requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.

PRACTICAL COMPOSTING.

A Plea for Adapting the Technique to the Raw Material and the Environment.

By G. B. Masefield, M.A. (Oxon.), A.I.C.T.A.
(*Agricultural Officer, Uganda Protectorate.*)

The subject of making compost manures has received a good deal of attention lately, and a number of excellent accounts have been published describing systems of composting. The danger of these methods is that they tend to become too systematic; and as one who has had experience of composting under varied climatic conditions, I feel that a word of warning against this tendency is desirable.

It is evident that composting cannot satisfactorily be reduced to rule-of-thumb methods. A system which is advocated for one place may be of little use in another with a different climate, and even from one season to another, with differences in rainfall, the same system will not prove satisfactory. For this reason, all systems which give a "time-table" of composting operations are to some extent a snare and delusion. The experienced composter will vary his methods from season to season and even from day to day. This is one reason why, to get the best results in large-scale composting, it is essential to have adequate expert supervision and not to rely upon unskilled native labourers only.

Pits or Heaps?

As an example of the need for flexibility, we may quote the much-vexed question of whether compost is best made in pits or in heaps. Pits are of course best under dry conditions, as the evaporation is much reduced; but they fail in wet climates or seasons. I have seen compost made in concrete pits without any provision for drainage; in a very wet season, there was standing water in the pits and the lower layers of the compost putrefied and became noxious. On the other hand, in very dry weather heaps may become so dried out that decomposition almost ceases and some of the material is actually blown away.

There are, of course, means of getting round both these disadvantages. I have made successful compost with garden refuse in a pit, the floor of which sloped down slightly to a drainage channel at one end. During a very wet season in Uganda, the rainfall just served to decompose the compost nicely without any addition of water, and the compost never became waterlogged.

Heaps, on the other hand, can be conveniently protected from evaporation during dry weather by laying a few coconut palm leaves along the top to form a thatch. During the wet season a good idea is to build them with the top sloping inwards to a central hollow so that all rainwater is caught and collected. Whether compost is best made under a roof or in the open depends on the climate, and also on whether the water-supply is sufficient to compensate for the rain lost by using a roof.

An experienced composter again will vary the size of his heaps, building them bigger in dry weather and smaller in wet. Another factor in which flexibility is desirable is the frequency of turning. In dry weather, excessively frequent turning leads to far too much loss of moisture. As an extreme example, I may quote an experiment in which two compost heaps were built, each containing at the outset 9 cwt. of fresh material. The experiment ran for 3½ months, during which one heap was turned weekly and the other not at all. At the end of that period, the unturned heap weighed 8 cwt., but the turned heap only 3 cwt.

This matter of control of moisture content is probably the most important single factor for success in composting, and too much insistence cannot be laid on frequent visits to the compost heaps and a flexible system which will take advantage of weather conditions.

The Fly Menace.

Another point to which great attention must be paid is the control of fly breeding in the compost. In most composts a sufficiently high temperature is reached in the interior of the heap to kill fly eggs and maggots. But the material at the edges does not reach this temperature, and therefore periodical turnings are necessary to ensure that this material is mixed up in the centre of the heap. In the case of the common house-fly, which is probably the commonest breeder in compost, the period from the laying of the egg to the emergence of the fly averages about 12 days in the tropics. It is therefore essential that the heaps should be turned at least every 10 days as long as the compost is fresh enough to attract egg-laying flies.

In any locality, it may be found that other species of flies are commonly breeding in compost. For example, in Trinidad *Leptocera ferruginata*, *Chrysomyza ani*, and an unidentified Tachinid fly were found to be of very common occurrence. Where this is so, the length of time from egg to emergence for each species should be ascertained, and the turning programme arranged accordingly.

Since flies breeding in compost may become a serious nuisance and in some cases a menace to the health of people or livestock, this is another reason for insisting that operations such as the turning of compost should be under responsible supervision. For the same reason, composting cannot be altogether recommended as an occupation for uneducated native peasants.

Materials for Composting.

In examining the suitability of different materials for composting, the chief consideration is to get the right degree of aeration in the mass.

For example, maize stover for composting is better chaffed than uncut; but the chaff cutter should not be set to cut too short, as this again leads to excessive compaction in the heap. Sugar-cane tops, being shorter, may be composted without chopping up. Rice straw, if composted by itself, becomes too compact and does not decompose, but it will rot well if mixed with other materials. Pea and bean haulm are rather too open for composting by themselves, but are a good lightener for cereal straws. In composting garden refuse, care should be taken not to include too high a proportion of lawn-mower cuttings, as these tend to compact themselves and lead to anaerobic fermentation and acidity. Weeds are difficult to decompose if too much earth is included with their roots; but Beckley (1) has overcome this difficulty by growing beans on the compost heaps, which assists rotting.

In general, it may be said that there are few types of agricultural refuse which cannot be composted if the right degree of aeration is obtained. Probably all of them rot better if mixed with other suitable ingredients than in the pure state, a fact which seems to have been too much overlooked in estate methods of composting. One of the exceptions seems to be tobacco stalks, which are very hard to induce to decompose. I have also had poor results with plantain leaves and peelings, both of which are a common type of habitation refuse in Uganda.

In cases where adequate aeration of the compacted mass is hard to obtain, this may be achieved artificially by placing ventilating tiles [Lambert and Davis. (2)] or lengths of bamboo pole under the heaps. Here again there is plenty of scope for ingenuity and flexibility of programme.

Experiments on Composting.

The techique of composting experiments has its own difficulties, which make it very hard to obtain results that are convincing to the modern statistically-trained critic. In a series of experiments carried out in Trinidad at the Imperial College of Tropical Agriculture on the effect of adding various substances such as dung, sulphate of ammonia, lime, and an inoculum of "activated compost" to composts with the object of accelerating decomposition, no results were obtained which reached statistical significance as to the benefit of any of these treatments.

One reason for this position is the difficulty of obtaining from a large and often heterogeneous mass of compost a small sample for chemical analysis which shall be representative of the whole. The statistically-minded may be interested to note that on two occasions when taking six samples from the same point in the same heap for measurement of carbon dioxide evolution, the sampling error proved to be 190 per cent. and 227 per cent. of the mean respectively.

Another difficulty lies in finding a suitable means of measuring rates of decomposition. After some experience in endeavouring to assess this by such methods as temperature records, chemical analyses, degree of humification, carbon dioxide evolution, and fungus and bacterial counts, I have come to the conclusion that there is no better criterion than judgment by eye and hand. A very useful technique is to take a few fibres from the compost mass in one's hand and roughly feel the breaking strain, by which means one soon becomes quite proficient in judging the degree of rotting. Eye and hand can take in the whole of the heap in a way in which sampling methods cannot, and can often deliver a judgment which cannot be translated into figures.

Although it appears therefore that experiments in composting are apt to be disappointing, I think that there is a danger in the fact that most of the writers who have advocated different systems of composting have worked these out quite empirically, have not compared them side by side with other systems which have proved good, and have not investigated a number of variations which might have greatly improved the process. It seems desirable that a much greater number of field trials in composting methods should be made, which may at present be of great assistance to the practical man, but from which accurate scientific results should not be looked for too soon. In estate practice, it is better for every composter to make his own experiments rather than to follow too slavishly methods which have been worked out for other localities and climates.

References.

(1) Beckley, V. A.—Composts and Composting. *East African Agricultural Journal*, Vol. II, p. 470, 1937.

(2) Lambert, E. B. and Davis, A. C.—The Distribution of Oxygen and Carbon Dioxide in Mushroom Compost Heaps. *Journal of Agricultural Research*, Vol. XLVIII, p. 587, 1934.

IMPERIAL BUREAUX PUBLICATIONS.

THE following are some of the publications obtainable. Full particulars are given in a list issued recently by the Executive Council, I.A.B., 2, Queen Anne's Gate Buildings, London, S.W. 1.

1. From the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts:—*Soils and Fertilizers*, bi-monthly; *Technical Communications; Bibliographies.*

2. From the Imperial Bureau of Animal Health, Veterinary Laboratory, New Haw, Weybridge, Surrey:—*The Veterinary Bulletin; Index Veterinarius.*

3. From the Imperial Bureau of Horticulture and Plantation Crops, East Malling Research Station, East Malling, Kent:—*Horticultural Abstracts; Technical Communications* and other publications.

4. From the Imperial Bureau of Plant Breeding and Genetics, School of Agriculture, Cambridge:—*Plant Breeding Abstracts; Technical Communications; Bibliographical Monographs.*

THE HISTORY OF INTRODUCTION OF SOME WELL-KNOWN WEST INDIAN STAPLES.*

By E. E. Cheesman.

The history of our domesticated plants is a comparatively recent study, dating only from the middle of the nineteenth century. Its pioneer was the Swiss botanist Alphonse de Candolle, whose "Geographical Botany" of 1855 is the best known, if not the first, application of modern methods in this sphere. The "Origin of Cultivated Plants" published by the same author in 1882 has become a classic.

One of the striking features of de Candolle's work is the frequency with which the author has to adjudicate between rival theories concerning the *hemisphere* of origin of well-known plants. It is natural enough that the exact geographical origins of our oldest crop plants should be obscured by the effects of human migrations and voyagings through the centuries, but confusion between the Old and New Worlds is another matter.

So far as cultivated species are concerned the two floras were quite distinct up to the time of the discovery of America by Europeans. It is true that many arguments have been advanced in favour of the view that there was some communication between America and Africa in prehistoric times; true also that there must have been communication between Asia and America in the north. But de Candolle himself remarks that in the history of cultivated plants he noticed no trace of communication between the peoples of the Old and New Worlds before the discovery of America by Columbus, and his conclusion has not been seriously shaken by any more recent discoveries.

In most cases even the genera of crop plants in the two hemispheres are distinct, and in the few cases, like that of cotton, in which the same crop genus was developed independently, we find that the species were different. Therefore, covering ourselves by the admission of one or two possible but very doubtful exceptions, we may accept the generalisation that there was not, in the first half of the fifteenth century, a single domesticated species common to both hemispheres.

The fact, then, that dispute can arise about the origin of species that must have been carried across the world by man within the last five hundred years, illustrates the difficulties of the botanical historian. It shows in the first place how completely some plants can become naturalized in a new environment and take on the appearance of natives. As a result of modern studies, botanists are now in fairly general agreement about the division of our crops between New World and Old World species, but in many cases their conclusions are based at least as much upon botanical considerations as upon historical records. Botanical facts such as the distribution of the nearest wild relatives of the crop, the degree of variation which it exhibits in different countries, and the natural means of dispersal available to it, are coupled with archaeological data and philological studies, as well as historical records, before the origins of cultivated plants can be taken as established.

The differentiation between Old World and New World species has been stressed in order to draw attention to a fact, apt to be overlooked so long as we neglect the influence of plants upon the affairs of men. The fundamental significance of the discovery of the New World lay in the additions it made to the world's vegetable resources. The prizes that attracted the conquerors were glittering gold and silver, but the real treasures of the Americas were their plants.

Within the tropical belt the range of staples was almost doubled, the major contributions of the New World to the Old being maize, cacao, rubber, tobacco, quinine and fine cottons. In return the American tropics received sugar-cane, coconuts, bananas, rice, coffee, citrus fruits and spices. Owing to their geographical position, and early discovery, the West Indian islands were in most cases the first beneficiaries of introductions from the Old World, and it is with a few of the plants in this category that these notes deal.

Sugar-cane.

Few aspects of West Indian history can be discussed without mentioning the sugar-cane, and that plant may appropriately take the first place in these notes. A little botany must precede the history. Modern sugar-cane varieties, thanks to half a century of attention from plant breeders, are works of art almost as much as of nature, and we can trace their ancestry back to four distinct species of the genus *Saccharum*. The older varieties with which we are concerned may be divided for our purposes into two groups, the thin canes and the thick canes or noble canes. These groups had separate origins.

The thin canes were evolved from wild grasses in the south-eastern corner of the mainland of Asia, probably round the head of the Bay of Bengal (1). They are supposed to have spread first from India into China, and appear to have been grown and used both in India and in Southern China as far back as history goes. The noble canes, more strictly tropical, originated independently and from a different though related species somewhere in the Pacific Islands. They were well established in Polynesia when the islands were first discovered by Europeans, and it has not yet been possible to determine the exact centre from which they spread.

* An Address delivered to the Trinidad and Tobago Historical Society on 14th April and published by courtesy of the Society.

It was the thin type of cane from India that first set out on its travels westward. We learn that in the year 600 A.D. sugar-cane was established at the mouth of the Euphrates, where Christian monks were the first to make white sugar (3). The Arabs, in their period of dominance round about the eighth century carried the plant first to the Levant and then onward into Spain, where there was a flourishing industry well before the year 1000 A.D. It is said that the Crusades served to develop the appetite of Western Europe for sugar.

The next step was due to the Portuguese, who carried cane to Madeira in 1420 and a little later to the Canary Islands, the Azores and West Africa.

Credit for its introduction to the New World goes commonly to Columbus, who on his second voyage in 1493 is said to have picked up cane at the Canary Islands and taken it to Hispaniola, or as we now say, Santo Domingo. Some authorities are silent on this point, and others suppose that the original plants were lost (6) and that a second consignment was brought over from Andalusia in the early years of the Spanish colonisation of Santo Domingo. However this may be, one Gonzalo de Valosa was the first to undertake the cultivation of sugar-cane on any considerable scale. This planter constructed a small horse-driven mill, in which the first West Indian sugar was made in 1509 (8).

From Santo Domingo the plant spread to the Spanish colonies on the mainland, reaching Mexico in 1520, Brazil in 1532 and Peru in 1533. The French and British Antilles received it much later, for the simple reason that they were colonized later.

Barbados, first colonized in 1625, seems to have had sugar-cane almost from the beginning, but not to have developed a sugar industry for the first fifteen years or so. Accounts vary, but according to one of them Captain Powell, who was in charge of the settlement, having landed the colonists sailed down to Essequibo in Guiana to visit an old Dutch comrade. The comrade must have had a well-stocked farm, for Powell returned with seeds and plants of cassava, yams, maize, sweet potatoes, plantains, bananas, oranges, limes, pine-apples, tobacco, cotton, anatto,—and sugar-cane. Others say that the sugar-cane was introduced from Pernambuco in Brazil, and yet others that Captain James Holdip planted the first sugar-canes in Barbados which he got from a ship from Guinea. More than one of these accounts may be correct, in so far as cane may well have been introduced by several persons independently in the early years.

There is a general agreement that the technique of making sugar was learnt by the first Barbadians from the Dutch. Some say that enterprising planters went down to Brazil to learn the process, but in any case there is little doubt that Dutchmen displaced from Brazil by the Portuguese went to Barbados and were induced to impart their knowledge of sugar making.

They had previously tried growing tobacco, but it is on record that it was singularly bad tobacco, and the sugar crop proved very much more profitable. Ligon mentions an estate of 500 acres which just before the coming of sugar could have been purchased for £400, and a few years later *half* of it was sold for £7,000.

Barbados was the first sugar colony that England possessed in the West Indies. When the cultivation proved so successful the plant was introduced in 1664 into Jamaica by Sir Thomas Modiford and in 1674 into Antigua by Colonel Codrington. The first introduction to Trinidad does not appear to have been recorded.

It is interesting and important to remember that all these early travels concerned a single variety of sugar-cane, and that it was a thin cane from India capable of growing as far north as Spain. So long as there was only the one, no particular name was necessary for it, but in later years when distinction became necessary it was referred to as the Creole cane. This variety is now virtually extinct in the West Indies, though it is said to survive in parts of Brazil. It is described as a short-jointed, medium-slender cane, green when unripe, with a light lilac banding at the upper end of each joint, ripening yellow. It gave poor tonnage, but had a sweet juice and soft tissue, that made it easy to mill and pleasant to chew. This character probably accounts for its selection in the first place from among the numerous varieties that India had to offer. "Direct consumption" of cane by chewing preceded milling and the manufacture of sugar, and where the Creole cane still survives it is said to be grown and sold for this purpose to the present day. As recently as 1928 the Creole cane was identified with an Indian variety called *Puri* (4).

The Creole cane was the only variety in the West Indies for at least about two hundred years, and according to most accounts for nearly three hundred. Then in the last twenty years of the eighteenth century there were a number of fresh introductions and the position was swiftly and completely changed. This time the noble canes of the Pacific Islands and the Malay Archipelago were the migrants.

In 1766-68 Bougainville sailed round the world, touching among other places Otaheite (Tahiti) in the Pacific and Mauritius in the Indian Ocean. It is generally assumed that on his voyage he carried canes from Tahiti to Mauritius. Bougainville's own account of the voyage makes no mention of the occurrence, but whether he was responsible or not, at about this time a thick yellow cane called *Otaheite* became popular in Mauritius and the neighbouring island of Bourbon (Réunion). In 1782, cane varieties in Mauritius were enriched by the importation of a number direct from Java by Cossigny. A few years later the French Government had these Java canes sent over to their West Indian colonies and Cayenne, and with them went the Otaheite cane, which on its arrival came to be

called, after its immediate origin, *Bourbon*. This history accounts for the two names, *Otaheite* and *Bourbon* applied to the same cane variety in the West Indies.

This Bourbon cane was established in Martinique in 1792, for in that year plants were brought down to Trinidad by Begorrat and planted in the Diego Martin valley (5). In the following year a Martinique planter gave cuttings to a Montserrat planter, and the variety also reached Antigua. It was introduced to Barbados by William Firebrace in 1796 and reached British Guiana in the same year.

The Bourbon cane gave greatly increased yields, and was destined to be the standard cane of the West Indies for almost exactly a hundred years. Its history is therefore important, but it is complicated by the fact that there was a double introduction. The second was due to Captain Bligh, whose adventures in the *Bounty* are too well known to need more than passing reference. On his second and successful attempt in the *Providence* Bligh dropped anchor at St. Vincent with his famous breadfruit in January, 1793, and he had also sugar-canes from Otaheite on board. The canes seem to have been taken on to Jamaica, and from illustrations by Tussac in his *Flora Antillarum* of 1800-08 it is known that there were four varieties. Of these only one was a yellow cane which could be the variety already known as *Otaheite* or *Bourbon*; the others were a green cane, a very stout purple cane, and a violet and yellow striped variety. The one which was yellow very closely resembled the Bourbon, but there seems to have been some doubt at the time whether it was truly identical or only closely similar.

Later, the names were accepted as synonymous, but various botanical observations suggest that there were at least two closely similar varieties of sugar-cane grown in these islands under the name of *Bourbon*. As the nineteenth century went on and various introductions had time to mix, the situation seems to have become still more complicated. J. H. Hart in the Annual Report of the Botanical Department, Trinidad, in 1904 goes so far as to say: "Personally I am of opinion that there is not only one but dozens of different kinds of the so-called 'Bourbon' canes . . . as a matter of fact, almost any yellow cane, unless it has some specially marked distinctive feature, is called a Bourbon on the estates."

The end of the Bourbon cane, brought on by its susceptibility to a complex of diseases, is too recent to concern the present discussion. It was important, however, as the direct cause of extensive programmes in cane-breeding. It is perhaps worth noting that to serve the needs of plant breeders, introduction and exchange of varieties of all crops go on in the twentieth century more vigorously than ever before. Most plant movements nowadays are recorded, but in view of the massive proportions of contemporary literature, the task of historians of the future who try to trace the adventures of particular varieties will be an unenviable one.

To complete the picture of the position at the end of the eighteenth century, we must return to the Java canes introduced by the French *via* Mauritius in the same shipment as the Bourbon. These also were duplicated. The Dutch had already introduced canes direct from Java into St. Eustatius and Surinam about 1780, and some, at least, were identical with the French introductions of a few years later. These, collectively known as Batavian canes, are noble canes but distinct from the Otaheite, being smaller and less juicy, but hardier. The best of them was perhaps one known at an early period as *Java Yellow Violet* and later better known as *White Transparent*. Under the name of *Crystalina* this cane held in Cuba the dominant position filled elsewhere by *Bourbon*. There were also purple canes among these immigrants. Several of the Batavian canes have contributed to modern varieties raised from them by various crosses.

Although the Dutch and French introductions are usually given as the source of Java canes in the West Indies, it is possible that some of them arrived in the Antilles a century earlier. In the second half of the seventeenth century, the governments in the French islands were agitated about the Jewish question, and some publications of the time have such a modern sound that one is tempted to digress. A local decree of 1658, for example, forbade Jews to carry on any commerce in Martinique. Policy fluctuated, and in 1671 the King of France instructed his Governor-General to give the Jews complete liberty and equal rights with French nationals, in consideration of the services they had rendered in cultivation of the lands. In 1683 the king, under political pressure, reversed his attitude, and told his administrators to drive the Jews out of the islands. It seems that extreme measures were never in fact taken and many Jews remained. The bearing of this upon our subject is that among the signal services rendered by them to the colonies it is recorded that a certain Jew by name Benjamin Dacosta introduced to Martinique the Batavian cane, very rich in sugar (9). Unfortunately no date is attached to this episode, but the context suggests the late seventeenth century. Also, Benjamin de Costa is mentioned elsewhere as introducing cacao to Martinique, and the date of that is 1661. The indications are, therefore, that at least one Java cane was known in Martinique a full century before other noble canes reached the West Indies through more official channels.

There are other indications that our history of the introduction of sugar-cane varieties to the New World is far from complete. There is, for example, considerable mystery surrounding the travels of the *Uba* cane, which seems to have got into Brazil in quite early times, and to have been taken back eastward to Mauritius in 1869 (3). The supposition is that it was carried by the Portuguese direct from India to Brazil, and this reminds us that there may well have been numerous

unrecorded introductions of various crop varieties by that route in the sixteenth century, supplementing those of which we know.

The outline that has been given may be very shortly summarized as follows: The thin cane later called *Creole* arrived in Santo Domingo from Spain about 1500, and spread from that centre. For at least 150 years it was the only variety in the West Indies, and even if there were Java canes in Martinique between 1650 and 1700 the *Creole* remained generally dominant until approximately 1800. Between 1780 and 1800 there were at least three separate introductions of noble canes—one by the Dutch from Java, one by the French from Mauritius, and one by the English from Tahiti. In a few years the Creole cane was almost entirely displaced by the Bourbon—Otaheite type (probably more than one true variety mixed) which was to dominate for the next century. Side by side with the Bourbon, the Java canes were grown on a smaller scale, and the three groups Creole, Batavian and Bourbon comprised all the varieties present at the beginning of the nineteenth century.

Citrus.

If Columbus's sugar-cane died, as it is believed, the earliest plant colonists in the West Indies were the citrus fruits. The testimony of Las Casas is definite that on his second voyage, in 1493, Columbus stopped for two days in the Canaries and bought a varied supply of livestock—heifers, goats, ewes, sows and chickens "and these became the seed whence has sprung all that there is to be found, in those parts, of the things of Castille, and so it was with the pips and seeds of oranges, lemons and citrons, melons and every kind of vegetable".

The earlier history of the several species may be very briefly summarized (10). They all originated in south-eastern Asia, the nursery of so many of our tropical crop-plants. From botanical considerations, and also the fact that they are mentioned and distinguished in Chinese literature dating back more than 500 years B.C., the best authorities place the origin of oranges and shaddocks in southern China. The citron, the lemon and the lime are of Indian origin and probably equally ancient. The keeping qualities of the fruits make them relatively easy to transport, and there are reasons to believe that oranges graced the banqueting tables of Rome in the first century of the Christian era.

Adaptable also as plants they were established at about that time or a little later in the Mediterranean region. The citron was the first to be established, probably in Greece, and its culture is discussed in some detail in an agricultural work of about 220 A.D. Among other things this treatise states: "It is also proper to know that the citron when budded is sterile; it is therefore proper to graft it in the wood in the same manner as you graft vines." The orange was also apparently grown in Pompeii in the first century, but apparently produced neither flowers nor fruit. It was the Arabs and Moors, in the eighth and ninth centuries, who really spread citriculture round the Mediterranean, and they are believed to have introduced the first citrus trees to the Canaries, whence Columbus obtained seeds.

In the New World the species flourished exceedingly, and as early as 1535 Oviedo speaks of orange trees innumerable, yielding fruit both sweet and sour, "there are also many lemon, lime and citron trees, and all of these produce large quantities of fruit of so good a quality as is not surpassed in Andalusia itself."

Southward in Brazil, one hundred years after the first introduction of citrus to the New World, Francis Suares writes to his brother Diego in Lisbon (in 1596) a long, chatty business letter about the trade up the Amazon to Peru (7) and remarks that "vinegar is solde for two and thirty, and sixe and thirty, and forty reals a jarre, by reason there is great store of limmons and oranges in this country". For comparison, olives were fetching half a real apiece, and comparing the probable bulk of a "jarre" of vinegar with that of 80 olives, one can understand that Sr. Suares found the vinegar trade unprofitable. Incidentally this reminds us that all the citrus fruits, including oranges, were chiefly valued in earlier days for their sour properties and used for seasoning rather than as they are chiefly used to-day. Also it may be remarked that these Brazilian trees were not necessarily descended from Columbus's introduction, as again the Portuguese may have brought them direct from India.

Northward in Florida the orange made itself so much at home that the first English colonists found whole groves of sour orange trees along the rivers, self sown from water-borne fruits, and at a later date some of these groves were top-worked with sweet oranges and used commercially.

In the seventeenth century there was a regular export of lime-juice from Jamaica to Europe, and it seems probable that fresh oranges were also shipped from the West Indies. A "Treatise on Foodstuffs" published in Paris in 1698 mentions "America" as one of the sources of oranges shipped to Paris, and by "America" the West Indies were most likely meant.

In the earlier accounts of citrus in the West Indies there is no mention of the shaddock, and although that fruit was grown by the Moors in Spain it does not appear to have been among the earliest introductions. The authority always quoted about its arrival here is Sir Hans Sloane, physician to Queen Anne, who visited Jamaica, Barbados and St. Kitts in 1687-88 and later wrote at length on the natural history of Jamaica. Obviously quoting what he had been told on the spot, he says: "The seed of this was first brought to Barbados by one Captain Shaddock, commander of an East-Indian ship who touched at that island in his passage to England and left its seed here." The story is probably correct, because there was a Captain Shaddock, and the application of his name

to the fruit was originally West Indian. Elsewhere it is usually called by some variant of the Dutch name *pompelmoes*, ranging from the polite *pomelo* to the more picturesque, if slightly vulgar, *pimple-nose*.

The origin of the grapefruit is something of a mystery. Tussac in his *Flora of the Antilles* of 1800-1808 says: "I have had the occasion to observe, at Jamaica, in the botanical garden of the Government, a variety of shaddock whose fruits, which are not bigger than a fair orange, are disposed in clusters (*en grappes*); the English in Jamaica call this the 'forbidden fruit' or smaller shaddock." A few years later it is written of the same fruit that it is "known by the name of *grapefruit*, on account of its resemblance in flavour to the grape." Arguing from the fact that the careful Sloane neither mentioned the grapefruit nor included it in his herbarium (now in the British Museum) some authorities believe that it originated in the West Indies during the eighteenth century. This it might have done, either as a sport from the shaddock, or as a chance seedling. As, previous to 1800, there is no distinction in terminology between the grapefruit and the shaddock, it is very difficult to trace the smaller fruit any further back.

Bananas.

We return yet again to south-eastern Asia for the origins of the bananas and plantains, the nearest wild relatives of which are indigenous in forests from north-eastern India down through the Malay Peninsula and Archipelago to the South Sea islands. These wild relatives have fruits full of hard seeds and very little edible pulp, but the seedless kinds are clearly developed from them, and it is likely that the development took place before the dawn of history. It is likely also that it took place independently in several centres, one in India, one in the Indo-Malayan peninsula, and one further east in the islands of the Pacific. Most of the varieties in the New World are members of the Malayan group, and they moved westward in much the same manner as sugar-cane and citrus. More strictly tropical than those plants, however, they took a more southerly route, overland across Central Africa rather than coastwise by way of the Mediterranean.

It is debatable whether the Arab traders were again responsible for the initial movement westward, for there is a body of evidence suggesting communication between the Malay Archipelago and Madagascar in much earlier times. There is at least no doubt that although the banana is not indigenous anywhere in Africa, it reached the eastern side of the continent many centuries ago. The degree of dependence of certain Uganda tribes on this crop for almost the whole of their food supply is one indication of its antiquity among them.

In any case the extensive Arab trade in ivory and slaves across Central Africa must have facilitated the movement of the banana overland, and it was well established on the western side when the Portuguese first explored the Guinea coast about 1470. Incidentally, "banana" is the Guinea name, and the term "guineo" widely used in Latin America for certain varieties also reflects this phase of the plant's history.

The Portuguese carried bananas from Guinea to the Canary Islands, and thence their progress to the New World followed the usual route. This time Columbus was not responsible; it was the Reverend Father Friar Tomas de Berlanga who took bananas to Santo Domingo, and the date was 1516. Berlanga subsequently became Bishop of Panama, and appears to have been a most worthy cleric.

Unfortunately we do not know which varieties of bananas he carried across, though it is fairly certain that one of them was the common plantain, and I believe that another was what we now call "Silk Fig". It is quite certain that the dwarf variety now generally known as the "Canary" banana was not among Berlanga's shipment, because this was a much later introduction both to the Canaries and to the West Indies.

This dwarf variety (variously known as Governor, Chinese, Canary or Cavendish) is a native of Indo-China now spread throughout the Tropics, but there is no record of its travelling westward before the nineteenth century. Its travels, once begun, are singularly interesting, and although part of them does not concern our subject directly, perhaps a short digression will be pardoned.

In 1826 one Charles Telfair in Mauritius obtained plants from Cochin China, and three years later he sent two to a friend named Barclay in England. One of them was purchased by the Duke of Devonshire and grown and fruited under glass at Chatsworth. The specific name *Cavendishii* was conferred on the variety at this time, from the Duke's family name, Cavendish. John Williams, the missionary, took plants from Chatsworth to Samoa in 1838, and two years later the Reverend George Pritchard carried the variety on to Tonga and Fiji. Thus in the short span of 14 years this globe-trotting banana travelled half-way round the world and back again. At the present time the dwarf is commoner in the Pacific than the indigenous varieties of the islands.

Its introduction to the Canary Islands and to the West Indies is a separate story, and took place a few years earlier. A French scientific mission was sent to the East, consisting of two ships, the *Durance* and the *Rhone* under Captain Philibert, with M. Samuel Perrottet as botanist to the expedition. It visited, among other places, the Philippines, where Perrottet collected plants of the Manila hemp (*Musa textilis*), and finished up at Réunion (Bourbon) in 1820. From Réunion the *Durance* returned direct to France, but the *Rhone* with Perrottet on board was sent to Cayenne. This prolongation of the voyage meant that the *Rhone* would reach France at the beginning of winter, and Perrottet therefore disembarked himself and his plants at Cayenne and remained there until the summer of 1821. He spent his

time in multiplying some of the useful plants in his collection, and has himself placed on record that "the banana called *little Chinese*" was among them.

Although the evidence is less direct, piecing together of the records indicates strongly that the *Durance* passing Teneriffe on her direct return to France was responsible for introducing the same banana to the Canaries.

The Gros Michel or Jamaica banana, upon which the export trade of tropical America is based, may possibly have come likewise in Perrottet's ship, though no mention of it is made in his writings. Its introduction is in fact an unsolved mystery. We know that it is the *Pisang Embon* or Dew Banana of Malaysia, and that it was taken into Jamaica from Martinique by Jean François Pouyat in 1836, but we have no inkling as to how it got to Martinique from its distant home. If it had been in Berlanga's shipment we should expect to find some mention of so good a variety long before 1836. If on the other hand the variety was comparatively a newcomer to Martinique when Pouyat thought it worth taking to Jamaica, then the Philibert expedition was as likely a source as any. Perrottet was sufficiently interested in bananas to describe several varieties, and one of them which he called *Musa nigra*, from the blackish coloration of the pseudostem, has not been identified since. His description is poor, but he emphasizes the size of the bunch, which may reach 20 kilos (40 lb.), and allowing for his method of description it is just possible to make "*Musa nigra*" fit the Gros Michel.

This suggestion is advanced as a possibility rather than a probability. There were many opportunities for the unrecorded arrival of a banana variety between 1516 and 1836, and it would in fact be rather strange if in the whole of that period there were no introductions. There appear, however, to be no records.

Coffee.

The various species of *Coffea* are all African in origin and, by contrast with the staples we have been considering, coffee is of comparatively recent cultivation. The home of so-called Arabian coffee is probably Abyssinia, and it would seem that berries of wild trees were used by the Ethiopians from very early times. The first cultivation, however, was in Arabia, at a date placed by some authorities as early as the sixth century A.D. and by others as late as the fourteenth century. It was in the seventeenth century that the use of coffee was introduced into Europe, and it quickly became popular enough to make its cultivation profitable outside Arabia.

Various accounts are given as to when and where the first coffee trees were grown outside Arabia, some saying that the Arabs themselves carried plants to Ceylon as early as 1505, others that the Dutch obtained them first in 1658. There is one record that a coffee plant was successfully transported from Mocha to Holland in 1616 (11) but if both date and identification are correct the plant must have died soon after. All that is certain is that coffee was established in Ceylon and in southern India some years before 1700. The Dutch succeeded in acclimatizing plants from Malabar in Java in 1699, and that date serves as a convenient starting point for us to trace the introduction to the New World.

A plant sent from Java to Amsterdam in 1706 was successfully raised to flowering and fruiting under glass in the Botanic Garden, and that plant was undoubtedly the parent of all the early coffee plantations in the West Indies. The authorities in Amsterdam generously distributed seedlings from it to some of the best known botanical gardens and private convervatories in Europe. They also, in 1714, sent plants to Surinam, which must have been the first coffee trees in the New World.

One of the Amsterdam plants was sent to the botanical gardens in Paris, in fruit, in July, 1714, and the French authorities who had for some years wished to introduce coffee to their West Indian colonies now had the opportunity. Their first attempt ended in a tragedy. In 1716 the French Academy of Sciences appointed a young doctor of medicine named Michel Isambert to go out to Martinique as botanist, to cultivate the useful plants of that island that could not be sent to France, and to act as correspondent of the Academy on subjects relating to natural history. Isambert was to take with him on the outward voyage some bees, silkworms and several plants including the precious coffee. The instructions given to him are most detailed, and interesting as a record of the technique used in transporting living plants by sailing ship. "The three coffee trees, which are in a box with moss, may be placed where you like on the ship until you come to warm latitudes. Then you are to take out one and plant it in a pot, which you will place under a glass case. It must be watered from time to time with a glass of water only, and if water remains in the tin basin in which the pot will be placed, you must be careful to remove it with a sponge. . . . It will be good to put warm water in the basin in the evening, to protect the tree against the cold of the night, and the basin should be surrounded with old sheets to conserve the warmth. The glass case must be put on the poop so that you can give air to the coffee from time to time, being careful to choose days when the sun is hot and to open the sash which faces the sun. In case of bad weather you will have a waxed cloth to cover the case, and it is especially necessary to be careful to tie it down firmly. The other two trees will be left in the box until you arrive, when you will plant them in two pots and put them in the shade for fifteen days. When they are well re-rooted you may risk putting them in the open. You should note which of the two methods gives the better success".

We may imagine Isambert tending his charges all the way across the Atlantic, for they arrived alive. But a few days after landing Isambert himself was dead of yellow fever. When the news reached France, instructions came back to send the plants on to a botanist in Guadeloupe, but by that time the coffee seedlings had perished.

The best-known account of how Martinique did eventually receive coffee plants has all the elements necessary to put it in the class of "romances" of plant introduction. According to this, success was first achieved by a French officer, Captain Gabriel de Clieu, who was returning from France to Martinique in 1723. He is said to have had difficulty at the outset in obtaining plants from Paris, and by his own account succeeded at last through the kindly offices of a lady of quality and the royal physician. This was only the first of his troubles. His ship narrowly escaped capture by a corsair out of Tunis, then encountered a violent tempest, and finally fell into a calm so prolonged that the drinking water ran short. There is a touching picture of de Clieu, cocked hat and sword behind him on the deck, sharing his small ration of water with his plant. An extra touch is given by the action of a fellow-passenger who, says de Clieu, "basely jealous of the joy I was about to taste through being of service to my country, and being unable to get this coffee plant away from me, tore off a branch". The only detail needed to complete a perfect story is that the gallant captain died in poverty, and this at least one historian has added, though others admit that after a distinguished career, including the governorship of Guadeloupe, he had a pension for his naval services.

Most of the story was told, fifty years later, by de Clieu himself, and it is a pity to spoil it, but it seems fairly certain that however true his adventures may be, his was not the first coffee in Martinique. M. A. Chevalier, in a thorough and well-documented account of the history of the coffee in the French Antilles (2) evidently regards Captain de Clieu's trouble as rather unnecessary.

We have seen that the Dutch sent coffee to Surinam in 1714. It prospered, and in 1719 the Governor of French Guiana politely asked the Governor of Dutch Guiana for seeds. The Governor of Dutch Guiana politely refused, pleading that he had strict orders not to let the plant out of Surinam. French records suggest that this was probably a reprisal for an incident in which two Dutch ships calling at Cayenne to trade had been refused permission to do so. Anyhow, this attempt at restricting plant exchange suffered a fate common to such designs, and just a year later the French authorities were rejoicing over 11 plants raised from seed from Surinam. They had been brought out by a Frenchman named Morgue, who seems to have got himself into trouble in Cayenne some seven or eight years previously and decamped with his wife and his slaves into Surinam. The record discreetly says that he was permitted to return, and brought the seeds with him. It is sad to have to add that he was dead a few weeks later, though pleasing to find a recommendation to the effect that if the home government was considering a reward for him, it should be given to his widow.

Also in 1720, a few months after the Morgue incident, a second opportunity presented itself. A detachment of troops was sent down to Surinam in a friendly way to take delivery of eleven deserters from Cayenne. When they got back, the lieutenant in charge and his men had coffee berries in their pockets, which they prudently presented to the Governor.

Thus, coffee was available in French Guiana three years before de Clieu set sail from France, and as Chevalier remarks, the Governor of the French Windward Islands was continuously in touch with the Governor of French Guiana. It is most unlikely that the Martinique Government, which in 1719 was actually proposing to send a ship to Mocha to get seeds, remained ignorant of the advent of the species in Cayenne. In February, 1726 there were in Martinique more than 200 bearing trees, more than 2,000 less advanced, and quantities of seedlings. It was quick multiplication if they all came from de Clieu's tree.

Cayenne was not the only colony to get seeds out of Surinam. A Captain Young also got some in 1720 and took them to Barbados, whence seven years later several pounds of coffee had already been sent to England. Brazil started its first coffee plantation with plants from French Guiana in 1727, and the plant was in Jamaica by 1730.

Here we may leave the early history of coffee in the West Indies. Species other than the Arabian, such as Liberian and Robusta, are introductions of the late nineteenth or the present century and fall outside the scope of these notes.

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A LIST OF PARASITES RECOVERED FROM POULTRY IN ANTIGUA, B.W.I.

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The writer in a previous report (1) included two species of internal parasites which were recovered from poultry in the island and the object of the present note is to report on additional parasites both internal and external which have been encountered.

Poultry in Antigua, as in most places have their quota of parasites but considering the conditions under which they are raised, housed and fed, the degree of infestation found was not exceedingly high.

Of the internal offenders, the tape-worm *Raillietina tetragona* and the eyeworm *Oxyspirura mansoni* are the most commonly found with the large round worm *Ascaridia galli* coming next in frequency.

With regard to the external parasites, one or two points of interest arise. The species *Megninia cubitalis* (Megn) is one of the feather mites. Dr. Ewing, Bureau of Entomology, U.S. Dept. Agriculture, states that he has no records of this species from the West Indies and that there seems to be none in the files of the Insect Pest Survey.

The fowl tick *Argas miniatus* is widespread and is found in most poultry houses and runs where poultry are kept. So far, no definite cases of fowl Spirochaetosis have been diagnosed as such, but the common occurrence of this tick which is the vector of the disease gives rise to great suspicion as to whether it exists or not.

The scaly leg mite is also very prevalent and the condition is found amongst most flocks where the majority of fowls are infested.

I am indebted to Dr. T. W. M. Cameron, Director, Institute of Parasitology, Macdonald College, Canada, for his kindness in having identified the internal specimens, also to Dr. C. F. W. Muesebeck in charge, Division of Insect Identification, U.S. Dept. of Agriculture and to Dr. Ewing for their identification of the external parasites.

Following is a list of parasites recovered:—

A.—Internal.

(1) *Raillietina tetragona*—Tape-worm.
(2) *Oxyspirura mansoni*—Eyeworm.
(3) *Ascaridia galli*—Large round worm.
(4) *Tetrameres* sp. (probably Americana)—Stomach worm.
(5) *Brachylaemus commutatus*—Caecal trematode.

B. External.

(1) *Megninia cubitalis.* (Megn) — Feather mite.
(2) *Argas miniatus.* (Koch)—Fowl tick.
(3) *Liponyssus bursa.* (Berl) — Tropical feather mite.
(4) *Cnemidocoptes mutans*—Scaly leg mite.
(5) *Dermanyssus gallinae*—Common poultry mite.
(6) *Lipeurus* sp.
(7) *Menopon gallinae.*
(8) *Goniodes dissimitis.* (N).
} Lice.

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THE OILS, FATS, AND SOAPS INDUSTRIES IN 1938.

Developments in the field of oils, fats and soaps during 1938 and the economic aspect of the production of these commodities synthetically form the subject matter of two articles by R. Furness in *The Industrial Chemist* for January and February, 1939.

Where an adequate supply of raw material for oils and fats is available, there is no need to consider the uneconomic production of fatty acids and fats from other sources by synthetic methods. In countries where economic laws do not prevail, notably Germany, considerable attention has been paid to the synthetic production of fatty acids suitable for use in the soap industry. By catalytic atmospheric oxidation of paraffin or suitable fractions of petroleum or coal oil at 115° C., a 10 per cent. conversion of hydrocarbon to acid is obtained. Of the crude acids so formed, 50 to 80 per cent. are available for soap making. This process has been applied on an industrial scale, but the small yield of fatty acid obtained, and the high cost of purification, render the method expensive and of no commercial application in countries where an adequate supply of raw materials is available.

Constitution and Composition of Oils and Fats.

Recent work by Hilditch and co-workers on the component fatty acids and glycerides of oils and fats has furnished additional support to the law of even distribution of component fatty acids in the glyceride molecules (the maximum formation of mixed in preference to simple, triglycerides). In addition, examination of the phosphatides of soya-bean and rape seed showed that all the characteristic fatty acids of the extracted oils are also found in the phosphatides, but in different proportions.

The newer technique of "molecular" or "short-path" distillation, as employed by Farmer and Van den Heuvel for the investigation of unsaturated fatty acids present in oils, is also discussed. By this method, isomerisation and

polymerisation are largely overcome, and greater yields of the acids in the state in which they exist in the fat may be obtained. The process has recently been successfully applied to the winning of sterols and other "trace" constituents from vegetable and fish oils, and it may also find application in the isolation of edible soya-bean oil which, by the ordinary process of refining, yields a product with an undesirable taste and which readily rancidifies.

With regard to the incidence of rancidity in oils, the use of an anti-oxidant (for the prevention or retardation of rancidity development) obtained from cacao bean shell is of interest. The anti-oxidant contained in the shells is extracted therefrom by the product to be protected, or by means of a solvent. In the latter case, the extract is added to the oil or fat-containing product. The process has been patented.

In referring to the hydrogenation of oils and fats Furness discusses the relative merits of nickel-kieselguhr catalysts and alloy-skeleton nickel catalysts. The latter are less readily poisoned than the nickel-kieselguhr variety, and show effective catalysis at temperatures lower than those normally used in oil hydrogenation operations using supported nickel catalysts. The alloy-skeleton nickel catalysts may be valuable therefore in the production of certain types of hydrogenated oils.

The production of homogenised and "soft curd" milk, and the emulsification of fat or oil and water (margarine "synthetic" cream, &c.) with the aid of supersonic vibrations, are also mentioned, though somewhat briefly, and the article concludes with reference to the question of soya-bean cultivation in Great Britain. At present, 2,000 acres are under cultivation but by 1940, it is hoped that this will be increased to 10,000 acres and by 1941 to 100,000 acres. The acreage under soya-bean cultivation in the United States in 1937 was 7,000,000, producing over 40,000,000 bushels of beans.—(*The Industrial Chemist*, Vol. XV, No. 168, p. 39, *ibid.*, Vol. XV, No. 169, p. 83, 1939.)

THE RUBBER INDUSTRY IN 1938.

In his article on The Rubber Industry in 1938, published in the January and February (1939) editions of *The Industrial Chemist*, A. S. Brazier confines his attention almost entirely to the progress in synthetics. Propaganda work in certain countries makes it difficult to determine the actual amounts of the synthetic rubbers which are being produced in these countries. For instance, the production in Germany of 25,000 metric tons per annum is quoted by *The India Rubber World*, whereas *The Financial Times* gives the production of *Buna* rubber in Germany as 1,500 tons per annum with 20,000 tons as the ultimate objective. Activity in the field of synthetic rubber is also being shown by Japan, Russia, Italy, Poland and Czechoslovakia.

The cost of production of *Buna* rubber is approximately 2/6 per lb.; that of the higher quality *Thiokol* and *Duprene* rubbers 3/6 per lb. It should be noted, however, that a project for the manufacture of a synthetic rubber at or below the cost of the natural material may be found to concern a product better described as a rubber diluent.

The production in Russia of synthetic rubbers from butadiene is briefly as follows:—85 to 90 per cent. ethyl alcohol is converted catalytically to butadiene (30 per cent. yield), which is purified and polymerised in nitrogen in an autoclave using 5 per cent. of sodium on zinc rods. Under suitable temperature and pressure conditions, 90 per cent. of the butadiene is polymerised in 36 hours. For the production of one ton of synthetic rubber by this method, three tons of alcohol are necessary.

The admixture of synthetic rubbers with various other substances has given some valuable results. *Neoprene*, for example, can be converted to a flexible ebonite having an excellent solvent resistance, whilst the additon of *Thiokol* to sulphur gives an adhesive of unusual strength and resistance to acids. Investigations have not been limited to the production of synthetic rubber from butadiene, however, for considerable work is being done on other plastic materials with rubber-like properties, such as the various vinyl polymerisation products. Polyvinyl chloride suitably plasticised can be used for tubing, cable-covering, artificial leather and flooring. Mixed with natural or synthetic rubber, it gives a product having a high dielectric value and therefore of special use in the electrical industry.

After discussing the ageing of various rubbers, the question of the oxidation of rubber and the effect of temperature and the addition of anti-oxidants on the mechanism and rate of rubber oxidation, Brazier concludes with an outline of the properties of and methods used for the preparation of various types of asbestos, together with the processes used for the manufacture of compressed asbestos-fibre jointing. For this purpose rubber and various compounding ingredients are first mixed on a mill, and the resulting compound immersed in solvent. The swollen rubber is broken down and the asbestos fibre introduced, the mixing being continued until a homogeneous mass is produced. The material is then sheeted out, branded, polished and cut to size.—(*The Industrial Chemist*, Vol. XV, No. 168, p. 27, *ibid.*, Vol. XV, No. 169, p. 70, 1939.)

BRONZE LEAF WILT OF COCONUT.*

THE first of these investigations was carried out on various estates in Trinidad. The external symptoms of Bronze Leaf Wilt, the yellowing of the three lowest leaves of bearing palms and later the younger leaves, appear to be identical with those of the "Red Ring" disease which is caused by a nematode parasite in the roots. This suggests, in the absence of any pathological organism, that the disease is due to some kind of root disturbance, and this in turn suggests adverse soil conditions.

A survey of the incidence of the disease in Trinidad showed that it tended to be more severe on certain types of soil, but that this could not be correlated in any definite way with the nutrient status of the soil. The physical nature of the soil, however, did appear to be important. The soils on which wilting was more severe were more compact than the soils in the healthy areas. Measurements of water table fluctuations showed that in some wilt areas water-logging occurred because of a subsoil which was slow-draining. In other wilt areas the soil was open-textured and free-draining leading to poor water supply in dry weather. Sometimes there was an intolerant subsoil which hindered root development. A study of the root systems of healthy and diseased trees showed differences, especially below two feet depth. In most cases of wilt, the lower layers of roots were found to be rotting.

As regards the nutrient status of the healthy and diseased trees, leaf analysis showed that apparently healthy leaves of wilting trees had a wide ratio of nitrogen to phosphate or potassium (according to the soil-type) than in the case of healthy leaves.

The symptoms of leaf wilt occurring in the Essequibo District of British Guiana described by Duthie, appear to be identical with those in Trinidad. Again soil analyses of good and bad areas failed to show any marked differences, but they indicated an accumulation of saline substances in the subsoil, which is probably the result of poor aeration and drainage. Another feature of importance in the case of the Essequibo District is that the coconuts are planted on soil that was previously under sugar-cane, which is a shallow-rooting crop. Thus the subsoil would tend to be compact. It was noticed that fields that are overgrown with bush do not show signs of wilt, and it appears that the undergrowth is beneficial in conserving moisture and removing the excess of saline substances from the subsoil.

At our present state of knowledge, we can ascribe the disease to a disturbance of the normal physiology of the tree. This disturbance depends on a number of factors of which the following are the more important:—(*a*) water relations of the soil on which depends to a certain extent the oxygen status of the soil, (*b*) the nutrient status of the soil, (*c*) the water balance of the tree, which depends on (*a*) and (*b*), and on atmospheric conditions.

In order to eliminate the disease, prevention rather than cure is desirable. On certain soil-types (where water-logging is likely to occur), benefit will probably be derived from digging deeper drains. Trenching with organic matter is also likely to be beneficial. In soils with a poor water-holding capacity, irrigation is recommended. In short, any cultural operations which would lead to better soil aeration and a more even moisture status are likely to lessen the incidence of the disease.

E. C. H.

* 1. Bronze Leaf Wilt Disease of the Coconut Palm. F. M. Bain, *Dept. of Agriculture*, Trinidad, 1937.
2. Coconut Wilt in Essequibo and Pomeroon Districts (British Guiana). D. W. Duthie, *Agric. Journal, British Guiana*, IX, No. 3, pp. 147-52, 1938.

MYCOLOGICAL NOTE.

In a recent number of *Phytopathology* (Vol. XXXVIII, page 673, 1938) R. B. Streets described a nursery blight of citrus caused by *Phytophthora citrophthora*. Some hundreds of budded sweet orange trees in a closely covered 'lath house' on a rather heavy wet soil were attacked and rendered worthless. The fungus apparently attacked the plants just above the bud union, blackening the stem and causing the leaves to wilt and die. The outbreak of the disease was attributed to the high humidity prevailing in the nursery at the time, and non-infected trees were saved by the prompt application of Bordeaux mixture.

In October, 1934, a similar outbreak occurred in a nursery of West Indian and T.1. limes in Trinidad. In this instance the fungus concerned was *Phytophthora parasitica* which attacked and killed the soft green tissues of the young lime scions. The nursery was on a heavy soil in an area with a high rainfall, and was lightly shaded with papaw trees. As the disease had only appeared at the height of the wet season, no remedial measures other than the destruction of some dozens of infected plants were attempted, and the disease disappeared at the beginning of the next dry season.

It is evident therefore that although it may be advantageous to shade citrus nurseries for the control of citrus scab and to protect them from the wind, this must not be overdone or severe damage may result during wet weather.

R.E.D.B.

AVOCADO CULTURE.*

There are three avocado races, namely, the West Indian, the Guatemalan, and the Mexican types. Each of these types requires a different elevation for its development and possesses different characteristics, as follows :—

The West Indian is a poor shipping quality, is loose-fitting, and has a rather large seed. According to Stahl it contains from 4 to 7 per cent. fat. The skin is medium thick and is always smooth and leathery. The seed coats are usually separated, and the cotyledons are rough on the surface. The fruit stem is short.

The Guatemalan has a thick woody rind, producing dull, large, and rough fruits. The seed is small and invariably tight-fitting ; the fruits are of good shipping quality, the meat of which is drier than that of the West Indian. The surface of the cotyledons is smooth. It contains more fat (from 10 to 13 per cent.) but less carbohydrates. The fruit usually is borne on long fruit stem. The young leaves are frequently reddish or bronze in colour instead of green.

The foliage of the Mexican is anise-scented, small and sharp at the apex. The fruit is small with thin, smooth rind which generally adheres to the pulp and is of purplish black in colour. It contains a higher percentage of fat (from 12 to 15 per cent.). The seed is large with thin coats which are either separated or adhering to the cotyledons. The surface of the cotyledons is smooth.

In planting avocado, one of the most perplexing problems is the choice of the right varieties, and this is due to a considerable variation in the productiveness of avocado trees. Some trees profitably bear fruits every year ; others, only in alternate years ; others do not bear any fruit at all. Many varieties fail to bear fruits satisfactorily owing to lack of pollination brought about by the failure of the flowers to open at the proper time or to the incompatibility of the pollen itself. Generally, fruit bearing in avocado will be more successful if compatible varieties are interplanted and if their flowers open at such time as will permit cross-pollination, or if self-compatible varieties are planted, the opening periods of flowers overlap. However, the varieties to be interplanted should have approximately the same flowering time—early varieties should not be interplanted with late varieties and *vice versa*. The midseason varieties can be interplanted with either the early or late varieties.

Of the hundreds of varieties now planted in the United States not a single one has so far been selected that gives all the desired qualities. Each has some defects. And these varieties will have to be replaced eventually by a more desirable variety, or strain.

When selecting the varieties to be planted, one should be guided by the following points : the trees should be hardy, productive, regularly bearing, disease- and pest-resistant, early- or late-bearing ; the fruit should be of good flavour, quality, and size ; and the seed should be comparatively small. It should be borne in mind that the fat content does not indicate a good quality, for in the United States the most prized varieties are poor in this respect.

Requirements.

The avocado is distinctly tropical and subtropical in its requirements. In localities where the dry season is not too long, they thrive with very little attention. However, when the dry season extends to four or five months, they require some irrigation unless the soil moisture is within the reach of the roots during the driest part of the year.

The tree is not exacting in its soil requirements so long as good drainage is afforded. It is very intolerant of standing water, and cannot endure it for any length of time. A deep and well-drained soil, which is rich in organic matter, is the best for avocado, but well-drained heavy soil of average fertility will also grow good avocado especially in moist regions. Any soil where citrus trees thrive will produce good avocado trees.

Like most other fruit trees, the avocado does not thrive well in places exposed to strong winds. Its leaves cannot quite resist excessively hot, dry winds. Besides, winds increase the evaporation of water which in turn may cause a heavy dropping off of immature fruits. Also the fruits are liable to suffer injury through rubbing against the branches or against each other, and the danger of the breakage of limbs, especially those heavily loaded with fruits, is increased. This is not, however, a limiting factor in avocado culture, because it can be remedied by planting windbreaks in places where there is no natural protection from winds.

The West Indian varieties are very tender, and are best adapted to low and medium elevations up to 900 metres above sea level. The Guatemalan varieties are rather intermediate, and have wider range of adaptability. They can be grown from sea level up to an elevation of 2,500 metres, but an elevation of not more than 700 metres is the best. The Mexican varieties are the hardiest with respect to cold weather, and have a wide distribution. They thrive best from 600 metres upward.

Propagation.

The avocado is propagated by seeds, by budding, grafting, inarching, or marcotting, but preferably by budding and grafting. Inarching and marcotting are too laborious and expensive. Grafting sometimes gives better results than budding. The grafted plants are often more vigorous than the budded ones. On the other hand, trees grown from seeds usually do not come true to type. The chances of obtaining a fruit of better quality than that produced by the parent tree are very small. It is the experience of avocado growers

* From an article by F. G. Galang in *The Philippine Jr. of Agric.*, Vol. IX, No. 3, pp. 315-325, 1938.

that seeds are unreliable means of reproducing a variety. If seeds have to be depended upon for the propagation of avocado, the seed of some avocado varieties may be carefully halved so as to produce two plants from each seed. The resulting plants should be given a reasonable dose of fertilizer in order to produce good growth. Generally the whole seed germinates earlier, and the resulting seedling is more stocky and has more leaves than the halved seed.

The first step in the production of budded or grafted trees is the raising of the stock plants. In the United States the varieties of the Mexican type are commonly used as stocks because of their greater hardiness against frost than the large-seeded and hard-shelled varieties in spite of the greater amount of plant food in the seed of the latter. But this type possesses a wide range of variability; caution should, therefore, be taken in using it as a stock plant. On the other hand, the West Indian seedlings, being generally more vigorous than the other types, may prove good stock plants at lower altitudes although they were less successful as scions for the Mexican stock. The Guatemalan type comes next to the West Indian and the Mexican stocks. This type is vigorous and thrifty, but somewhat tender although less so than the West Indian. Fuerte, a hybrid between Guatemalan and Mexican types is at present much used as a stock in the United States.

As the seed of the avocado loses its vitality quickly, it should be planted while it is still fresh. If the seeds cannot be planted at once, they should be stored in properly moistened sand, sawdust, charcoal, or sphagnum moss. The seeds may be planted directly in bamboo pots or in seed beds with the pointed end up. About one-fourth of the seed should be left exposed so that the resulting sprouts can be thinned out, leaving the strongest one. The seeds are set 40 or 50 cm. apart in the seed beds. In potting, the soil should contain one-third each of sand, loam, and well-rotted compost. If sown in seed beds, the soil need not be so rich—a sandy loam soil being sufficient. It is sometimes advisable to grow the seedlings for budding or grafting in the seed beds although it will require more labour to remove them properly when transplanting them in the field. Seeds should not be allowed to dry out, otherwise they will lose their viability.

Budding or grafting is done in the same way as in citrus or other fruit trees. It can be done any time the stem of the stock plants has become a little larger than a lead pencil provided it is not raining and that the seedlings are in condition, that is, the sap is flowing freely. The scion should be selected from the best tree of the desired variety, should be well matured, preferably from twigs which are just ready to send out new growth, and should contain plump and well-developed buds.

Avocado stem is very brittle so that in forcing the bud to grow, a notch should be made a few inches above the bud instead of cutting the stem half-way into the wood of the stock for lopping as in the case of other fruit trees. In lopping never bend the stock as in other fruit trees in order to avoid a premature breaking. When the scion is already well advanced, the top of the stock may be cut off entirely about 10 cm. from the bud. After the bud has grown to a length of about 25 cm., the stock should be cut off clean just above the union of the stock and the scion, and the cut surface should immediately be painted with white lead or other suitable materials. This will protect the wood from decay.

Planting.

When the plants are about 50 cm. high or more, they can be transplanted in the field at the beginning of the rainy season, at a distance of about 8 to 10 metres apart in holes large enough to accommodate the plants. Set the plants as deep as they grow in the nursery, and use good surface soil for refilling the holes. The soil should be packed firmly around the plant. It is well to pour in water while compacting the soil. If water is available, planting may of course be done late in the rainy season, and even during the dry season. In transplanting, great care should be taken not to injure the root system which is very delicate, and the roots should never be exposed to dry or else the plants will die. To avoid the least injury to the roots, the plant should be dug from the nursery with a ball of earth. In planting balled trees, it is unnecessary to remove the sack or wrapping materials from around the ball of earth as the sack will eventually decay. To facilitate rotting and the penetration of water, two or three cuts should be made at the sides of the sack with a sharp knife. Split and remove the pot in transplanting the potted plant. Cut one-half of the leaves or young twigs of the plant previous to transplanting. The newly transplanted plants should be watered and mulched from time to time as may be necessary. In watering, a basin should be made around the tree to hold the water. Newly transplanted plants must be shaded during the dry season.

Orchard Management.

A modern fruit tree orchard should be well cultivated, irrigated, fertilized, cover-cropped, pruned, and mulched from time to time. The cultivation of a young avocado orchard is done in the same way as in citrus, that is, deep ploughing is advisable at the beginning; but when the trees are already big, deep cultivation should be avoided as much as possible, otherwise there is danger of destroying part of the root system and exposing the soil. At this stage the tree can be kept clean by occasional hoeing of the ground near its trunk. Mulching the trees and planting cover crops between the spaces are also beneficial. Legumes are more valuable as cover crops than non-leguminous plants.

In order to get the most profit from the trees fertilizers should be applied regularly to bearing trees.

A young tree requires very little, if any, commercial fertilizer until it begins to bear fruit heavily. Animal and poultry manures and nitrogenous commercial fertilizers are, however, beneficial to young avocado trees. A complete fertilizer which is low in nitrogen and high in potash is good for fruit-bearing trees. In the United States a mixture containing 5 per cent. nitrogen, 7 per cent. phosphoric acid and 2 per cent. potash, the nitrogen being derived from organic materials, has given good results on young trees when applied at the rate of one pound per tree, three or four weeks after planting, and 8 to 10 pounds on five-year old trees. The percentage of potash is increased while the trees come into bearing—5-8-3 or 6-6-3 in spring; 4-8-10 in the fall, and 4-7-5- or 5-5-5 in summer.

As a general rule, avocado requires little or no pruning at all after the tree is properly established. The pruning of forking branches and shortening of young and spindling twigs may be done to strengthen the stock and the framework of the growing tree. This is to be done at their dormant stage. The mere pinching of undesirable shoots may induce the growth of other buds where an extension is needed in order to make the trees more or less symmetrical in growth. Tall growing trees should be pinched back. Again, some thinning of the branches should be done from time to time so as to permit sunlight into the inside foliage. Of course, any heavy pruning should be avoided, as this will greatly accelerate vegetative growth and delay the fruiting period. Only dead and undesirable branches should be removed after the fruits have been harvested. All wounds should be painted with white lead or other suitable materials to avoid rotting.

It is often advisable to top-work undesirable trees in the orchard to a good variety. This can be done by cutting the tops back including the big branches. Of the numerous sprouts which appear, only a few good ones should be left for budding or grafting with selected scions. The cut surfaces and the trunk should be painted and whitewashed in order to protect them from decay and sunburn.

Avocado trees grown from seedlings begin to bear fruits when about four to eight years old, six being the average. On the other hand, vegetatively grown trees sometimes begin to bear fruit the first year in the nursery. At this age, however, and probably up to three years, they should not be allowed to fruit. The annual yield of a full-bearing tree ranges from a few to 500 fruits—sometimes from 800 to 1,200 fruits. An average of 500 fruits a year per tree is considered a fair yield. Generally the yield varies from one season to the next, partly depending upon the size of the previous crop, rainfall, winds, and the conditions of the tree at the flowering season.

CITRUS MARKETING CO-OPERATIVES IN PALESTINE.*

The commercial export of oranges from Palestine began about 60 years ago. A planting boom began in 1923 and by 1937 the exports had risen to 11,500,000 boxes, a figure which is expected to increase to 25,000,000 boxes in the next four or five years. Citrus accounts for 80 per cent. of Palestine exports and employs 200,000 people out of a population of 1,250,000. Over half the export is in the hands of co-operative societies.

The co-operative movement is wholly Jewish. The Arabs, who cultivate 40 per cent. of the citrus acreage, have no co-operatives functioning, although considerable co-operative propaganda and advice has been supplied by Government. Privileges in the form of reduced taxation and loans at low rates of interest would probably have been more effective in this case. It is only after repeated representation that societies have been authorised to advance to members against crop liens.

There are eight packing and marketing co-operatives, four of them federated for selling purposes in the Jaffa Orange Syndicate, Ltd. A few smaller societies exist for credit purposes only. In 1937-8 the marketing societies had 2,129 members, 21,375 bearing acres and an export of 5,794,481 boxes. All these societies are democratically organised. Each individual member has one vote; no subsidiary co-operative (for instance a packing station) may exercise more than one-twentieth of the total voting power. Each settlement, however small, sends a representative to the Board.

Some societies are regional, others cover the whole of Palestine. A certain measure of overlapping results. In some societies members do their own packing, which is checked by inspectors at railways and ports. Others have centralised packing, which greatly facilitates equitable pooling. The independent societies undertake both the financing and marketing of members' crops. Those affiliated to the Jaffa Orange Syndicate, however, have transferred marketing to the federal body. There is now a general tendency towards federation and the re-shuffling of membership on a regional basis in order to avoid competition and expand markets. The danger is that since there is no Government compulsion of growers to join, outsiders may benefit more than members from such organisation.

One society has established direct trading relations with the Co-operative Wholesale Society of Great Britain, an example which should be followed and extended.

* Summary of a paper by I. Rokach, presented at the Imperial Conference of Agricultural Cooperation.

WEST INDIAN NOTES.

(*Compiled by the Advisory Department, Imperial College of Tropical Agriculture.*)

The Cotton Industry.

The area planted in Sea Island cotton in 1937-38 amounted to 15,887 acres being 1,163 less than the acreage estimated by the West Indian Sea Island Cotton Association for that season and 882 acres more than the previous season. The increased acreage was planted in Antigua and Nevis.

The total production of Sea Island cotton lint amounted to 2,200,200 lb., equivalent to 5,501 bales of 400 lb. each. This quantity was 1,407 bales more than the total production of the previous year. The increase was due to a record crop in St. Vincent and to increased production in Antigua, Nevis and St. Kitts. In general the Islands which planted cotton in the latter part of 1937 experienced a good cotton season.

Production of Marie Galante cotton lint amounted to 288,249 lb., equivalent to 695 bales of 400 lb. each, an increase of about 20 per cent. on the crop of the previous year.

Average prices obtained during the year were slightly less than during the previous year. Prices for the Montserrat strain ranged from 1*s.* 4*d.* to 1*s.* 8*d.* per lb., whereas for the superfine St. Vincent strain the range was higher at 1*s.* 8*d.* to 2*s.* per lb.

Final production figures for the year 1937-38 are set forth in Table I.

Production in 1938-39.

Conditions in St. Vincent and Nevis in 1938-39 were not so favourable as in the previous year and production will in consequence be considerably less. In Antigua better conditions have been experienced. A reliable forecast of production in the current crops in Montserrat and St. Kitts cannot yet be made. The estimated production for the 1938-39 crop is set forth in Table II.

Table II.—Estimated Acreage and Production, 1938-39.

Island.	Acres.	Production.		
		Lint. lb.	Bales of 400 lb.	lb. per acre.
		Sea Island.		
Anguilla ...	400	32,000	80	80
Antigua ...	2,000	200,000	500	100
Barbados ...	25	2,500	6	100
Montserrat	4,500	675,000	1,687	150
Nevis ...	2,500	250,000	625	100
St. Kitts ...	1,000	200,000	500	200
St. Vincent	5,000	400,000	1,000	80
Virgin Is. (British) ...	225	16,875	42	75
Total ...	15,650	1,776,375	4,440	—
		Marie Galante.		
Grenada ...	5,250	240,000	600	46
St. Vincent	700	50,000	125	71
Total ...	5,950	290,000	725	—

Table I.—Production and Export Figures for Cotton in 1937-38.

Island.	Acres.	Production, 1937-38.					Export, 1938.			Bales of 400 lb.
		Lint.			Bales of 400 lb.	lb. per acre.	Lint.			
		Clean (lb.)	Stained (lb.)	Total (lb.)			Clean (lb.)	Stained (lb.)	Total (lb.)	
					Sea Island					
Anguilla ...	400	22,804	505	23,309	58	58	22,802	671	23,473	59
Antigua ...	1,600	166,727	8,275	175,002	438	109	166,768	7,900	174,668	437
Barbados ...	33	3,253	—	3,253	8	99	3,183	—	3,183	8
Montserrat ...	4,453	508,097	33,440	541,537	1,354	122	400,496	31,965	432,461	1,081
Nevis ...	2,986	361,622	13,523	375,145	938	126	362,713	13,933	376,646	942
St. Kitts ...	1,440	320,937	64,193	385,130	963	268	304,597	25,037	329,634	824
St. Vincent ...	4,900	652,208	38,727	690,935	1,727	141	647,463	38,058	685,521	1,714
Virgin Is. (British) ...	75	5,718	171	5,889	15	78	5,718	—	5,718	14
Total ...	15,887	2,041,366	158,834	2,200,200	5,501	—	1,913,740	117,564	2,031,304	5,079
					Marie Galante					
Grenada ...	5,250	—	—	222,600	556	42	—	—	222,600	556
St. Vincent ...	718	65,649	—	65,649	139	91	—	—	65,649	139
Total ...	5,968	65,649	—	288,249	695	—	—	—	288,249	695

The Fruit and Vegetable Industry.

Total exports of tomatoes in the Leeward Islands in 1938 were only slightly less than in 1937. Increased exports from Antigua and Nevis compensated for a decrease in exports from Montserrat.

Exports of tomatoes from St. Lucia and the Leeward Islands during the years 1935-38 are set forth in Table III.

Table III.—Tomatoes.

(In 20 lb. tomato lugs.) 1935-38.

Island.	1935	1936	1937	1938
Antigua ...	—	—	2,104	5,493
Montserrat	18,631	45,869	41,278	35,001
Nevis ...	794	713	778	3,031
St. Lucia ...	—	—	—	21
Total ...	19,425	46,582	44,160	43,546

Exports of oranges, avocado pears and mangoes from St. Lucia and the Leeward Islands during the years 1935-38 are set forth in Table IV.

Table IV.

Island.	1935	1936	1937	1938
(a) Oranges. (In 2 cu. ft. citrus crate.) 1935-1938.				
Dominica ...	10,746	12,754	14,019	10,448
St. Lucia ...	291	126	107	269
Total ...	11,037	12,880	14,126	10,717
(b) Avocado Pears. (In 20 lb. tomato lugs.) 1935-1938.				
Antigua ...	—	—	127	10
Dominica ...	3,726	5,158	4,845	6,294
Montserrat	—	—	41	27
St. Lucia ...	3,857	3,336	3,960	3,604
Total ...	7,583	8,494	8,973	9,935
(c) Mangoes. (In 20 lb. tomato lugs.) 1935-1938.				
Dominica ...	3,462	8,616	6,056	8,204
Montserrat	300	157	173	22
Nevis ...	—	—	—	1
St. Lucia ...	6,556	8,046	9,591	10,391
Total ...	10,318	16,819	15,820	18,618

REVIEWS.

STATISTICAL TECHNIQUE IN AGRICULTURAL RESEARCH.

By D. D. Paterson, *McGraw-Hill Book Co. Inc.*, London, 1939, pp. 263. *Price* 18*s*.

The authors of books on agricultural statistics are of two kinds, mathematicians who have acquired a knowledge of agricultural science, and agricultural scientists who by inclination or of necessity have trespassed in the mathematical preserves. The former may be better fitted to advance statistical methods, but there is no doubt that the latter have great advantages in expounding modern experimental technique to agricultural students. Paterson is of the latter class and his approach to the problem is calculated to reassure the timid beginner. Few mathematicians can resist the temptation to give at least an indication of the proof of an abstruse mathematical theorem of which only the application is immediately relevant. Paterson dismisses such matters with "Mathematicians have proved . . .". Few books on statistics achieve such a satisfactory attitude to the subject. The author has written a manual of instructions for the use of a valuable set of tools, which is just what the agricultural student requires.

All the standard statistical methods are adequately treated, with sufficient detail and examples to enable the reader to grasp the method, as well as the simplest forms of calculation. The chapter on field experiments is particularly good, and lays much needed emphasis on the importance of deciding what you want to know, and what is the easiest and most efficient way of finding it out, before laying out an elaborate and possibly expensive experiment. In Chapter IX on recent developments, various refinements and special cases are treated in less detail than the general principles expounded earlier in the book. The student will want to know of the existence and importance of such special methods, and for more detailed information he is referred to special publications, the more important of which are listed in the bibliography.

A little more elaborate treatment might be given on two points. The first is on significance. The conventional nature of the accepted P=0.05 level of significance is fully explained, but there is an unfortunate tendency among agricultural scientists to assume that if there is no significant difference, there is no difference at all. If there is no significant difference, such differences as exist may be due to the accidents of sampling, or they may be real differences which the experiment was not sufficiently sensitive to detect with certainty. The distinction is important, and when clearly borne in mind, inconclusive trials will frequently indicate the treatments that are worth following up with more elaborate experiments.

The second point is with regard to serial experiments, where the student should be cautioned against a combined analysis of experiments having different error variances.

The book is well and clearly written, and well produced. The more important tables are included in an appendix. It may be confidently recommended as a text book to students, and as a reference book to agricultural officers in charge of experimental work.

J. B. H.

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COMMON BRITISH GRASSES AND LEGUMES.

By J. O. Thomas and L. J. Davies, *Longmans, Green & Co. Ltd.*, London, 1938, pp. 124, *Price* 6*s*.

This is an excellent little book for its purpose, but is not intended for the tropical agriculturist. It was written to meet the needs of farmers, schools and Agricultural Colleges in Great Britain, and to provide them with a handy guide to the indentification of the various pasture and fodder species in the field. Its chief interest in the tropics is that it might well serve as a model for local publications of a similar kind. The clear line drawings are especially commendable.

E. E. C.

* * *

THE GENETICS OF GARDEN PLANTS.

By M. B. Crane and W. J. C. Lawrence, 2nd Edition. *Macmillan & Co., Ltd.*, London, 1938. pp. 287, *price* 12*s*. 6*d*.

The first edition of this book was reviewed in *Tropical Agriculture*, 12, p. 165 in 1935, and the fact that a second edition was called for in rather less than four years is a well-earned tribute to its authors. The new edition is expanded by fifty pages and re-arranged, and a good book has been made better. The expansion is chiefly due to the inclusion of very recent researches, bringing the work as nearly up to date as it is possible for any textbook dealing with plant-breeding to be.

This reviewer still doubts whether the first three chapters are either necessary or desirable, whilst still admiring their ingenuity as an exercise in compression. If the book continues to grow, as there is every reason why it should, the feasibility of beginning at Chapter IV should be considered.

For the benefit of readers who are not acquainted with the first edition, it may be noted that "The Genetics of Garden Plants" deals only with the garden plants of temperate climates, but uses them to illustrate the principles and progress of modern plant breeding. A happy combination of the results of genetical researches with horticultural history, and plentiful illustrations, make the work very readable, as well as informative, to anyone who has enough interest in the subject to have mastered the principles of plant genetics.

E. E. C.

HESPERIDES.

A History of the Culture and Use of Citrus Fruits by S. Tolkowsky, *John Bale, Sons & Curnow, Ltd.*, London, 1938. pp. 371, with 113 pl.; 10 figs., 5 tables, *Price* 21*s*.

From 500 B.C. to the date of publication, from China to Peru, or from Pompeiian mosaics to bronze tea pots, there would seem to be very little connected with the history of citrus fruits that can have escaped the scrutiny of the author. Certainly he modestly admits a realization that he has left many a source untapped, and we know that completeness in matters historical is beyond mortal powers, but the amount of material that Mr. Tolkowsky has gathered together is as amazing as his scholarly presentation of it is admirable.

This is the sort of book that has footnote references to literature on every page, and so far as the ordinary reader can judge, it shows every mark of being as accurate and reliable as a scientific work of reference ought to be. Anyone concluding that it is therefore dull will be woefully misled. The reviewer has remarked first upon its thoroughness because he judges that that tribute will be most appreciated by the author, who alone knows how many years of labour the book has cost. But the matter has been most skilfully marshalled into connected chapters to make a readable whole, and for the hundreds who will be grateful for the scholarship there will, we hope, be thousands to thank the author for entertainment.

Any attempt to do justice to the range of "Hesperides" in a short review must be unfair to the book, but some imperfect indication may be obtained from a list of things that first caught the eye as the pages were idly turned at random. Here they are:—orange blossom in Japanese poetry; the conditions of navigation between China and the Malay Archipelago in the time of Marco Polo; citrons in ancient Greece; the use of mica for protecting plants in Roman gardens; orange trees in Moorish Granada; orangeries of seventeenth century Europe; the Bells of St. Clement's, Nell Gwynne. William of Orange could hardly be omitted in a work of such scope, but Mr. Tolkowsky goes one better and brings in Sir Robert Peel.

On closer and more serious study the book is found to be full of good things, and the 113 photogravure plates are a worthy embellishment of the text.

E. E. C.

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SCIENTIFIC AND INDUSTRIAL RESEARCH, 1927-1938.

Bulletin No. 69 of the Department of Scientific and Industrial Research, pp. vii+113+25 figs. (Wellington, N. Z.—*E. V. Paul, Govt. Printer*) 2*s*. 6*d*.

Under the title of "Scientific and Industrial Research, 1927-1938" the New Zealand Department of Scientific and Industrial Research has

just issued an illustrated bulletin describing the main lines of research upon which it is engaged, and the results that have been obtained since its establishment in 1927.

The Bulletin does not give a detailed account of the results obtained in the numerous lines of investigation that have been undertaken, since this information is available in the Department's official Journal and reports. Its purpose is rather to survey broadly the main research activities under the general direction of the Council of Scientific and Industrial Research, the objects for which they have been undertaken, and their economic value to New Zealand. Its appeal is therefore to the layman as well as to the scientist.

Following upon an introductory section briefly describing the organization of the Department, in which is included a useful map showing the location of the various research institutes and field activities, the functions and work of the main research institutes such as the Dairy Research Institute, the Wheat Research Institute, are described with the aid of appropriate photographs and maps.

A very efficient organization for co-operative work on plant research has been built up in the form of the Plant Research Bureau whose work on the study and control of plant diseases, the selection and breeding of pasture and field crops, the control of insect pests, and on systematic and economic botany, respectively, is described.

Results obtained in experiments on the nutrition of fruit-trees are described under the heading "Fruit Research". Particularly important is the discovery that boron is an effective cure for corky-pit of apples, a disease which has caused serious economic loss in the past. Preliminary experiments on the gas-storage of apples to improve their keeping qualities and post-storage life, and on the production of unfermented fruit juices are also described.

The development of soil surveys in New Zealand and the work being done by the Soil Survey Division of the Department in systematically surveying and mapping the soils of New Zealand as a basis for their economic utilization is concisely reviewed. A coloured soil map of part of the Heretaunga Plains illustrates the part being played by soil survey in the land utilization survey of the Hawke's Bay province which has recently been completed.

In the field of animal research, the main line of investigation followed by the Department is in connection with the study of mineral deficiencies, particularly bush-sickness and related diseases. The description of the co-operative work leading to the most important discovery that bush-sickness is caused by a deficiency of cobalt, and can be prevented and cured by administering minute amounts of that element, makes an interesting story, and is an outstanding example of the great economic benefit that can accrue from the application of research.

A section of the bulletin describes research on the selection and breeding of new and improved strains of *phormium tenax* (New Zealand flax) and on the processing and utilization of phormium fibre. Recent improvements effected in decorticating machinery have resulted in the designing of a machine which should make possible a marked increase in the quality of the fibre produced and a corresponding decrease in the costs of production.

Investigations on the composition and utilization of kauri gum are also referred to. As a result of the latter work, a process for the purification of low-grade gum by solvent extraction has been worked out, and proved to be technically and economically feasible, provided that a continuous supply of the raw material can be obtained at a competitive price.

At the tobacco research station recently established at Motueka work has begun, in association with the Cawthron Institute, on tobacco seed diseases; the control of mosaic disease; and chemical investigations on tobacco soils and the quality of tobacco-leaf. A large-scale investigation on mosaic disease and the importance of various factors in its dissemination has already been completed and published.

The Bulletin concludes with accounts of the growth of research associations both in the primary and secondary industries, of the work of the Social Science Research Bureau, of the Department's activities in the field of geophysics, coal and radio research, and of the work of the permanent scientific services.

CONTROL OF PRICKLY PEAR.

Some years ago the prickly pear was invading certain parts of Queensland at the rate of about one million acres a year. The invasion has now been arrested largely through biological methods of control and according to the *Australian Sugar Journal*, XXX, No. 4, 1938, up to 30th June, 1937, nearly 19 million acres of infested lands had been reclaimed, of which 18 million acres have already been taken up for purposes of development. The common pest pears, *Opuntia inermis* and *O. stricta* have ceased to be dangerous through being effectively destroyed by the *Cactoblastis* moth and cochineal insects. Most promising results have also been obtained with the *Cactoblastis* aided by a special strain of the cochineal insect on tiger pear, *O. aurantiaca*. Certain species of cochineal have affected considerable destruction of the tree pears known as *O. tomentosa* and *O. streptacantha*, and the larvae of a large beetle, *Lagochirus funestus*, are also accomplishing splendid work.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Sugar-Cane × Bamboo Hybrids.—*By H. M. L.*

Early last year* there appeared a brief account of the success achieved at Coimbatore in crossing the sugar cane with a species of bamboo (*Bambusa arundinacea*). A pleasant Christmas greeting from Coimbatore has taken the form of a mimeograph, illustrated by photographs, containing later information including observations on the F2 generation.

The earlier intergeneric cross between sugar-cane and *Sorghum* may be considered as an attempt to improve the cane plant by speeding up the life cycle. Though two of these hybrids are now grown to a limited extent in commercial cultivation, these crosses have failed through defective vigour in growth. The bamboo here used is a giant grass attaining a height of 50 to 100 feet, with a life cycle extending over some thirty years. The attempt may, therefore, be described as one of improvement by extending the life cycle.

The difficulties encountered were considerable, particularly in the matter of bringing the two plants into contact at the right stage for fertilization. The flowering habits of the sugar-cane are well known; those of the bamboo are still more unpredictable. A whole clump will develop inflorescence, but the year when this will take place is indeterminate. This formed the first difficulty to be overcome. The earliest attempts were made in 1931 when plants of the sugar-cane were potted and transferred to the vicinity of bamboo clumps in the forest where the air becomes heavily charged with bamboo pollen. Incipient setting of seed was noted, but the attempt came to an unfortunate end owing to the inquisitiveness of wild elephants and their dislike of this invasion of their natural haunts.

A second attempt was made in 1936 when the bamboo pollen was brought from the jungle to the Station by relays of coolies and bus. As a result 18 plants were obtained with POJ 213, a parent of the popular canes Co 213 and Co 281, as mother plant. A later method adopted takes advantage of the well-known characteristic of the bamboo that isolated stumps, separated from the parent plant, will flower at the same time as the main clump. Stumps taken from clumps in the forest about two months before the sugar-cane flowering season were transported to the Station where they were established and flowered over a period of some three months, thus giving a daily supply of pollen.

Sterility is a common feature in intergeneric hybrids and most of the sugar-cane × Sorghum hybrids showed this characteristic. The same was to be expected in so wide a cross as that between the sugar-cane and the bamboo but, fortunately, the results belied anticipation, for the F1 plants were found to set seed freely and a thousand F2 plants are reaching the end of their first year of growth. These are the result of open pollination, but there is little doubt that the majority are the consequence of selfing; in fact, in one case of a hybrid, special adaptations for self-pollination have been observed. As is only to be expected, a wide range of variation is found even in the F1, no two plants being alike. The bamboo characters appear with greater or less emphasis in the different members of the F2 generation.

One characteristic of the bamboo is the manner in which the buds on the rhizome dip downwards before ascending to form the erect aerial shoot. The F2 hybrids show this characteristic in very varying degrees. Another characteristic which may have economic importance is the way the bamboo gradually spreads its rhizome from its original centre until it occupies a not inconsiderable area. Its capacity for tillering is, consequently, largely increased as compared with the close tillering sugar-cane. This character, too, certain of the F2 hybrids possess, and it is one which may affect tonnage since some of the hybrids possess a combination of the close tillering of the sugar-cane and the extensive rhizomal system of the bamboo.

Three further characters of the bamboo are apparent in greater or less degree in the hybrids. These are: mode of branching which is spreading in the bamboo; hollow stem between which and the solid stem of the sugar-cane all degrees are found in the hybrids; axillary buds—between the large buds of the bamboo set at a sharp angle and the small closely apposed buds of the sugar-cane varying degrees are found.

The inflorescence of the sugar cane shows a wide range of variation and an even wider range is found in the hybrids. The variation extends to the size and shape of the spikelets and callous hairs.

It is noted, as a peculiarity, that while, among thousands of crosses between POJ 213 and other canes, the original parental types have not been observed, in the F2 of the sugar-cane × bamboo plants similar to the parents are found among other forms hitherto unknown and among these latter are forms easily superior in vegetative habit. Even though no economic forms eventuate from the direct cross, the possibilities of "nobilization" by back-crossing on to the sugar-cane will be vastly extended.—(*Int. Sugar Jr.* Vol XLI, No. 483, p 95, 1939.)

* *I.S.J.*, 1938, p. 10.

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Preservation of Cane Juice for Factory Analysis.—*By T. Tanabe and T. Yoshida.*

Corrosive sublimate (mercuric bichloride, $HgCl_2$) gave the best results, 0.1 grm. per litre preserving juice almost perfectly for two days. Dry basic lead acetate added at the rate of 2 grms. per 100 c.c. showed an increase in the pol. of 0.1°S. after 24 and 0.15°S. after 48 hours. Mercuric iodide, formalin, sodium benzoate, β-naphthol and sodium salicylate were effective only for about six hours.—(*Int. Sugar Jr.*, Vol. XLI, No. 482, p. 69, 1939.)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Manure from Lime and Molasses.

A process by which a solid product can be prepared from molasses has been perfected by the Indian Institute of Science. This product can easily be powdered and stored indefinitely in bags, can be transported without difficulty, and handled with greater ease than molasses for a variety of industrial uses. When molasses is treated with finely powdered, freshly burned lime, and stirred to form an intimate mixture, the lime slakes with a considerable evolution of heat. A portion of the water in the molasses combines with the lime, though a considerable quantity is driven off by the heat of reaction. The reaction proceeds to completion in a few minutes, leaving scarcely any free sugar in the medium. After mixing, the mass is poured out, and after ten minutes, the temperature rises to 70° C. and in five to ten minutes thereafter, begins to boil, the temperature reaching 105° C. There is a swelling of the mass and the formation of a dark brown liquid. Additional mixing hastens the reaction. When cooled, the material is dry and easily powdered. This product keeps well, even in open containers, is not hygroscopic, and does not cake or lump, even after prolonged exposure to humid atmospheres.

The proximate composition of the final product is: moisture, 4.5 ; carbonate carbon, 0.7 ; organic carbon, 23.5 ; nitrogen, 0.3 ; calcium as oxide, 26.2 ; potassium as K_2O, 3.5 ; phosphoric acid, P_2O_5, 0.08. This composition can be varied by changing proportions of lime and molasses. As is well known, cane sugar combines with one or more molecules of lime to form different stable compounds. It is yet to be determined which compound is most suitable for each type of application. Use as a fertilizer is suggested, since the molasses contains a considerable part of the soluble minerals removed by the cane or beet from the soil. That the sugars present facilitate fixation of atmospheric nitrogen in the soil has been shown by workers both in India and elsewhere. Use of the dry product obviates the difficulties met in applying liquid molasses to land. It is low in phosphoric acid, but this deficiency can easily be met by combining a small percentage of crushed bone or powdered phosphate with the material or applying it separately. The mild alkalinity of the material will prevent the accumulation of high acidity in industrial fermentations, and will indicate it as suitable for production of acetic, lactic, citric, and other such acids. Some research has been undertaken to determine whether a plastic may be made with the new product as a raw material, and preliminary experiments have been conducted on road surfacing. It may also be found useful as an adhesive and as a binder or spreader in insecticidal sprays.—(*Ind. & Eng. Chemistry*, News Edition, Vol. 17, No. 4, p. 138, 1939.)

Industrial Use of Papain.

The use of papain in American industry is increasing rapidly, judging from import statistics, which indicate that the consumption in the United States of America has increased fourfold during recent years, according to the Commerce Department's Chemical Division. Papain is the dried milky juice obtained from the skin of the unripe papaya (papaw) fruit. While the papaya fruit flourishes throughout tropical and subtropical regions of the world, some being grown in Florida, Texas, and California, Ceylon is the only country which produces commercial papain in large quantities.

In the United States, papain has long been used in medicine ; in recent years, however, it is finding its greatest use in the manufacture of "food tenderizers". In 1938, the United States imported 223,000 pounds of crude papain valued at $329,000 against 180,000 pounds valued at $205,000 in 1937, and 54,000 pounds valued at $50,000 in 1932. Of the amount imported in 1938, Ceylon supplied 173,000 pounds ; the United Kingdom, 36,000 ; Japan, 8,000 ; Siam, 5,000 ; and New Zealand, 1,000 pounds. Shipments shown as coming from the United Kingdom are believed to have originated in Ceylon.—(*Ind. & Eng. Chem.*, News Edition, Vol. 17, No. 4, p. 134, 1939.)

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Humus and Disease Resistance and Mycorrhiza.

UNDER a different title (*Insects and Fungi in Agriculture*), Sir Albert Howard has recently published a very stimulating discussion of this topic (*Empire Cotton Growing Rev.*, 15 July, 1938). His thesis is that insects and fungi are not the true causes of plant diseases ; these result from poor nutrition, disease resistance being the natural reward of healthy and well-nourished protoplasm. "The first step is to make the soil live by seeing that the supply of humus is maintained." Sir Albert then stresses the significance of the return of humus to the soil by means of the conversion of vegetable refuse into humus as in the Indore process. He points out the remarkably rapid improvement resulting when humus is applied to derelict plantations of tea, rubber, &c., results that are so striking that it is difficult to attribute them to the response of the crop to better soil tilth, &c. He concludes that the effect must be connected with the proper development of mycorrhiza in the roots, and during a recent tour of tea plantations in India and Ceylon, in co-operation with Dr. Rayner, he obtained additional evidence pointing in the same direction. Sir Albert suggests that the fungus component may enable the rapid transfer of accessory growth substances from the soil to the host plant, but this ingenious suggestion remains at present purely speculative.—(*Nature*, Vol. 142, No. 3,600, p. 801, 1938.)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Markets have ranged as follows (c.i.f. per cwt.):—

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
23rd February ...	6	1½	9	2⅛
2nd March	6	2¼	9	11¼
9th March	6	3¾	10	0¾
16th March	6	3¾	10	0¼
23rd March	6	6	10	3
30th March	6	6	10	3
6th April	6	6	10	3¾
13th April	6	6	10	6¾
(13th April, 1938) ...	4	10½	8	6¾

The strained European political situation has largely influenced the market and with a good general demand for both Raws and Refined, much of the latter being in the nature of scare purchases, the market has shown a gradually hardening tendency. Prices on balance show an advance of about 3¾*d.* per cwt. on quotations at the beginning of March.

* * *

RUBBER.—Quotations for plantation sheet have ranged as follows:—

	Pence per lb.
22nd February	8 1/8
1st March	8 5/16
8th March	8 3/8
15th March	8 3/16
22nd March	7 15/16
29th March	8
5th April	7 15/16
12th April	7 15/16
(13th April, 1938)	5 5/16

Although the market has been fairly steady it has been entirely dominated by political developments which have reduced the volume of business to a very low level. British motor factories are reported to have had an exceptionally busy month in February, while the figures for American consumption for that month at 42,365 tons are regarded as being very good. There has, nevertheless, been a marking down of prices in sympathy with political uncertainties.

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COCOA.—Cocoa arrivals in New York during the past month were exceptionally large, and undoubtedly, manufacturers received heavy deliveries. This probably accounts for their manifesting only a nominal interest in the market. The marketing of the world's largest crops may now be considered completed in primary markets.

The European situation remains tangled, and judging from the increase in the war risk insurance rates, the outlook apparently is not very promising.—(*By courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*)

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association:—

	American Mid.	*Egyptian Giza 7.*	*F.G.F. Sakel.*
24th February ...	5.18	7.02	7.02
3rd March ...	5.29	7.12	7.12
10th March ...	5.40	7.19	7.19
17th March ...	5.27	6.95	6.95
24th March ...	5.16	6.88	6.88
31st March ...	4.92	—	—
7th April ...	4.92	—	—
14th April ...	4.82	—	—
(14th April, 1938) ...	4.89	7.12	8.07

Prices of raw cotton after showing a further upward movement have fallen sharply on reports that the U.S.A. may release loan cotton although so far no official announcement has been made. There has been rather more business done in West Indian Sea Island at firm prices.

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BANANAS.—Prices have improved at £18 5*s.* delivered London and £18 10*s.* delivered station Provinces. Brazilians are in fair demand at the unchanged prices of £15 for London and Provinces.

* * *

COFFEE.—Costa Rica, improved demand, bold London cleaned from 64*s.* 6*d.* to 120*s.*, country cleaned from 67*s.* to 126*s.* 6*d.* Kenya, good to fine continue to sell well but medium and ordinary difficult of sale. "A" sizes from 64*s.* to 127*s.*; "B" sizes from 60*s.* to 90*s.* and "TT" from 50*s.* to 65*s.* Brazil, Superior Santos 30*s.* 6*d.* c.i.f. and No. 7 Rio 22*s.* 3*d.*

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GRAPEFRUIT.—Imports into the United Kingdom for the fortnight ended 15th March amounted to 12,158 cwt. consigned by the following countries: Palestine, 8,087; Jamaica, 669; British Honduras, 2,044; Netherlands, 1,073; and U.S.A., 249.—(*West India Committee Circular*, 23rd March 1939.)

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LIME PRODUCTS.—*Lime Oil.*—Handpressed is nominal at 27*s.* 6*d.* per lb. Distilled. Buyers are reserved and awaiting future developments. *Lime Juice.*—For concentrated, there is no demand. Raw is quiet with prices unchanged.—(*West India Committee Circular*, 23rd March, 1939.)

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SPICES.—*Pimento.*—The market was dull and prices showed no change. *Ginger, Nutmegs* and *Mace* were also quiet at previous quotations.—(*West India Committee Circular*, 23rd March, 1939.)